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construction innovation

NRC · CNRC

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NRC-IRC Centre for Sustainable Infrastructure Research in Regina is open for business

The space has been leased, the offices have been furnished, the laboratories are waiting, a number of staff are in place, and the research connections are beginning to gel. The stage has been well set for the NRC-IRC Centre for Sustainable Infrastructure Research (CSIR) to get up and running. And now, the planned technology cluster in sustainable infrastructure in Regina, Saskatchewan should really begin to take off, with benefits for the community and for the whole country.

The first CSIR projects will focus on water and wastewater infrastructure, including performance of water mains, life-cycle management and risk-based decision modelling. This choice of projects reflects the needs expressed in a number of town hall meetings in Regina and an NRC-led innovation round table held in cities across Canada in May 2003. It is also in line with the findings of the *Civil Infrastructure Systems Technology Road Map*, a document that outlines Canada's infrastructure challenges over the next 10 years.

An integrated research effort

Since CSIR's announcement more than a year ago, NRC-IRC has been working on the time-consuming realities involved in establishing a world-class research facility: recruiting highly qualified personnel, leasing a suitable home for the facility, liaising with local industry and exploring potential projects. This process is now wrapping up—although recruiting continues—and the Centre is open.

CSIR will be at the heart of an integrated research effort with the University of Regina's Centre for Sustainable Communities, the City of Regina and Regina's local industry. All partners will work closely on projects, optimizing their chance of success.

"We've leased office space in a building adjacent to the university campus to facilitate the free flow of staff, and ideas," says Dr. Don Taylor, Director of CSIR and IRC's Urban Infrastructure Program. "CSIR researchers will become adjunct professors at the university and involve students in their projects. In some cases, CSIR and university researchers will share laboratory space to encourage collaboration."

Going even further, CSIR staff will be charged with finding projects—and champions for them—among Regina's local industry. As part of the process, the City of Regina will serve as a kind of "living laboratory," ensuring that the tech-

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The NRC-IRC Centre for Sustainable Infrastructure Research (CSIR) is now up and running in a building adjacent to the University of Regina campus, to facilitate the free flow of staff, and ideas. ***Photo courtesy of Saskatchewan Research Council***

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Commission approves code changes, ending this codes cycle

The Canadian Commission on Building and Fire Codes (CCBFC), the body comprised of volunteers that is responsible for the national model codes, has just approved the content of the 2005 editions of the national model building, fire and plumbing codes. The new objective-based codes will be published and available for adoption by the provinces and territories in mid-2005. This will end the 10-year codes development cycle and wrap up the implementation of the CCBFC's 1995 strategic plan.

The members of the CCBFC met in Victoria in April to approve the content of the 2005 editions of the national model building, fire and plumbing codes.
Photo courtesy of Gibson Photography

Before starting to prepare for the next editions of the codes, senior staff at IRC's Canadian Codes Centre were asked to reflect on the highlights of the past decade.

"We made great strides in three areas," said Richard Desserud, recently retired manager of the Codes Centre. "First of all, the new objective-based codes are unique to Canada. After much analysis and deliberation, Canada decided not to follow the path recently taken by other countries in adopting performance-based codes, and chose instead an objective-based approach. This was done to build on the significant knowledge base code users already have, rather than start from scratch."

The 2005 codes have the benefit of retaining the current mix of prescriptive and performance requirements, allowing for the addition of more performance requirements in the future. This more inclusive approach lets Canada add acceptable alternative solutions to the existing codes while at the same time providing additional information now to help code users compare alternative approaches to code requirements.

The second, but no less important, advance is related to the changes made to Canada's code development system. While the CCBFC has always worked closely with stakeholders on the technical front, it is now working much more closely with the provinces and territories on the policy side. This integrated approach with the provinces and territories means that the priority changes requested by the provinces will be able to be incorporated more quickly into future editions of the codes, with fewer technical differences between (similar) requirements in the provincial codes and the national model core codes.

The third area of advancement was the publication of supplementary information for users of the model codes. "Codes have to be written in legally enforceable language," says John Haysom, project manager for the 2005 objective-based codes. "Our goal was to provide additional information to help users understand and apply the codes, and we've made a good start on that. The intent and application statements linked to every provision in the objective-based codes, combined with user's guides, provide that information, in plain language."

"We couldn't have completed the numerous projects over the past decade without the contributions of

In the past decade, the National Research Council Canada has published these new information documents:

User's Guide – National Plumbing Code of Canada 1995
User's Guide – NBC 1995: Fire Protection, Occupant Safety and Accessibility (Part 3)
User's Guide – NBC 1995: Structural Commentaries (Part 4)
User's Guide – NBC 1995: Environmental Separation (Part 5)
User's Guide – NBC 1995: Housing and Small Buildings (Part 9)
User's Guide – NBC 1995: Application of Part 9 to Existing Buildings
National Housing Code of Canada 1998 and Illustrated Guide
Model National Energy Code of Canada for Houses 1997
Model National Energy Code of Canada for Buildings 1997

To see the complete set of code documents or to order, visit http://irc.nrc-cnrc.gc.ca/catalogue/codes.html.

the members of the Commission, the standing committees, the task groups and many dedicated staff of NRC, and the provinces and territories," said Bruce Clemmensen, CCBFC chair, in summing up the achievement. "With the support of these experts, Canada has developed a set of codes and user's guides that rank among the best in the world."

What's ahead for Canadian codes?

Discussions on priorities for the next code cycle are already underway. Denis Bergeron, the new manager of the Canadian Codes Centre, will be responsible for addressing the challenges set by the Commission, the provinces and the territories for the next five years. As well, the Production and Marketing group is exploring e-commerce and fee-for-service options such as online code subscriptions.

What improvements would you like to see? To contribute your ideas to the development of priorities for the next code cycle, contact John Archer, Secretary to the CCBFC, at (613) 993-5569 or e-mail john.archer@nrc-cnrc.gc.ca.

Codes Upcoming event

October 6-8

5th International Conference on Performance-Based Codes and Fire Safety Design Methods. European Commission Facilities, Luxembourg. http://www.sfpe.org/sfpe/education/eventdetail.cfm?eventid=57

NRC-IRC Centre for Sustainable Infrastructure Research in Regina is open for business

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nologies resulting from the projects move readily into practice. Regina's supportive local government is expected to play a key role in enabling the infrastructure research to take place.

Communities of Tomorrow

In addition, as part of the partnership, Regina is now home to the 'Communities of Tomorrow: Partners for Sustainability,' or CT, a not-for-profit corporation for research on sustainable communities. This new organization will initiate and fund research, demonstrations and commercialization projects, and collaborations that meet the requirements of sustainable development by improving quality of life, while also producing environmental and economic benefits.

Communities of Tomorrow's board of directors oversees the cluster's research and project selection committee and approves planned projects. The board also oversees all partnership activities. To achieve balance, the board includes members from each of the groups involved in the research effort, as well as from Saskatchewan Industry and Resources and Western Economic Diversification. Expanding the board to include private sector members is currently under consideration.

"It's been a whirlwind year, but it's been rewarding," says Taylor. "With our partners we're creating an entirely new entity in Regina, and it's exciting that we are really starting to move forward."

For more information on CSIR or the Regina technology cluster initiative, please contact Dr. David Hubble, Manager of CSIR, at (306) 780-3208, fax (306) 780-8549, or e-mail david.hubble@nrc-cnrc.gc.ca.

Funding for the Regina sustainable communities cluster

- Federal funding through the NRC-IRC Centre for Sustainable Infrastructure Research (CSIR): $10 million over five years
- The University of Regina with the creation of its new Centre for Sustainable Communities: $5 million over five years
- The City of Regina as a "living laboratory": $5 million over five years
- Saskatchewan Industry and Resources: $5 million over five years
- Western Economic Diversification: $5 million over five years

TOTAL: $30 million over five years

The NRC model of cluster development

Knowing that successful clusters are built upon teamwork and a common purpose, NRC has developed a process that takes advantage of local strengths while leveraging NRC's national and international capabilities and partnerships.

It's easy to see this process at work in the new Regina cluster in sustainable infrastructure. Members of Regina's business, university and government communities have come together with NRC to develop a vision and a plan to make the cluster a reality.

But Regina is not the first community in Canada in which this process has played out. NRC's Plant Biotechnology Institute in Saskatoon recently opened its Industry Partnership Facility to support Saskatoon's world-class agrifood biotech cluster. NRC's Institute for Ocean Technology in St. John's is establishing a cluster in ocean engineering. And NRC's new National Institute for Nanotechnology in Edmonton promises to create a cluster in nanotechnology around one of the most technologically advanced research facilities in the world.

CCMC celebrates 15 years of success built on service to the industry

Not long ago, the Canadian Construction Materials Centre (CCMC) marked its 15th anniversary. Although not a huge milestone, it was enough of an occasion to pause and look back on an organization that began small and grew steadily to fill industry needs.

CCMC started in 1988 when Canada Mortgage and Housing Corporation's (CMHC) Materials Acceptance Department moved to NRC after extensive consultation with the provinces and territories. In doing so, it became Canada's national technical evaluation service for innovative building products, which reduced the need for such services in every province and territory across the country.

"When I came to CMHC in 1981 to head materials acceptance, it quickly became clear to me that our function could serve a broader need in Canada," says Gordon Walt, who spearheaded the move. "I looked at the evaluation services available in other countries and thought that Canada should have them too. It eventually happened, but it took seven years to plan and implement."

At NRC, CCMC has gradually broadened its scope and adapted to the needs of the construction industry as a whole. When it was first moved from CMHC, CCMC focused on evaluating the products used to build houses. Success in that field opened the way for evaluations of any products or technologies used in the construction of buildings. Now CCMC is evaluating products and technologies used in the maintenance and repair of Canada's infrastructure systems, including roadways, bridges and buried utilities (sewer, water, cable). This new service comes under the umbrella of CCMC and is called the Canadian Infrastructure Technology Assessment Centre (CITAC).

Throughout this change, CCMC's rationale has always been simple: if regulators, builders, architects and others in the construction industry have reliable information about the safety and effectiveness of new building products, they will use them. Innovative products will gain quicker acceptance, and unique products will gain new markets. Total revenues from construction in Canada is worth a little over one hundred billion dollars (12% of GDP) annually in Canada, so improving efficiency and profitability, and helping new products succeed in the marketplace are very important to the Canadian economy.

CCMC's ability to adapt to changing needs has paid off: CCMC evaluations provide an avenue for construction products to reach, and succeed in, the Canadian marketplace. Since 1988 the organization has produced and published 1043 listings on standardized products and 336 evaluation reports on innovative products for acceptance by building officials. In addition, CCMC staff contribute to the development of Canadian product standards and routinely provide technical support to building officials throughout Canada.

But CCMC's influence has not been limited to Canada. CCMC has also participated in Government of Canada trade missions to Japan, China, Korea, Chile and Russia. These visits have allowed Canadian manufacturers to make international contacts and gain international exposure for their products that might not otherwise have been possible. Examples of the success of this approach include the introduction of a Canadian building system to South America, the use of Canadian windows in Japan, and the opening of an entire market for wood-frame construction technology in Russia.

CCMC's chronology of achievements

1988 Materials Acceptance Department at CMHC moves to NRC and establishes the Canadian Construction Materials Centre (CCMC).

1991 NRC establishes the Canadian Commission on Construction Materials Evaluation (CCCME) to oversee CCMC. Its 23 voting members represent different regions of Canada, sectors of the Canadian construction industry, and users of CCMC's evaluation, technical information and listing services.

1991 CCCME forms the Standing Committee on Technical Evaluations, which is responsible for the quality and reliability of technical evaluations and reports.

1996 CCMC, with 24 other organizations from 21 nations, formed the World Federation of Technical Assessment Organisations (WFTAO) to help the transfer of innovative construction products to the global marketplace.

1997 CCMC establishes the Canadian Infrastructure Technology Assessment Centre (CITAC) to expand technical evaluations to innovative technologies and products used in infrastructure construction and repair.

1997 CCMC creates the Web-based Registry of Product Evaluations http://irc.nrc-cnrc.gc.ca/ccmc/regprodeval_e.shtml.

2000 CCCME establishes the Standing Committee on Infrastructure Technology Assessment to review technical evaluations and reports for infrastructure products.

"CCMC was one of the founding members of the World Federation of Technical Assessment Organisations (WFTAO) and has contributed significantly to the evolution of this organization," says John Berndt, former CCMC manager, who has just stepped down as WFTAO General Secretary. The WFTAO was organized to facilitate the transfer of products from its member nations to the global marketplace, through the acceptance of technical evaluations provided by its members.

Increasingly, Canadian industry is seeking out CCMC, to lend credibility to its efforts in penetrating international markets. CCMC does this by working with its counterparts in other countries to identify appropriate assessment requirements and determine the most effective means of obtaining acceptance of Canadian construction-related products.

For the next 15 years, there's no doubt that more of the same successful adaptation to changing needs is in store for CCMC—and whatever else is needed to support innovation, productivity and efficiency in the Canadian construction materials industry. John Flack, the current manager, says, "CCMC is well positioned to respond to the expected increase in product innovation resulting from the introduction of the new objective-based codes."

Specific questions can be directed to Dr. John Flack at (613) 990-8518, fax (613) 952-0268, or e-mail john.flack@nrc-cnrc.gc.ca.

New Chinese building code opens markets for Canadian wood products

The Chinese Ministry of Construction (MOC) has just released its new Chinese Timber Structural Design Building Code (GB50005), which will make wood-frame houses a viable alternative to traditional concrete construction in China. The new code features a detailed chapter on North American-style wood-frame construction, presenting a tremendous opportunity for the sale of Canadian wood products to China.

Canada contributed significantly to the development of the Chinese code, with Forintek Canada Corporation playing a lead role in providing technical input to the Chinese expert committee. The resulting code incorporates requirements similar to those for wood construction in both Part 4 and Part 9 of the National Building Code of Canada. This input was made possible as part of a memorandum of understanding between Canada Mortgage and Housing Corporation (CMHC) and China's MOC, with major funding from Natural Resources Canada's (NRCan) Canada Wood Export Program and the Province of British Columbia's Forestry Innovation Investment Ltd.

Specific questions can de directed to John Berndt at (613) 993-5353, fax (613) 941-0822, or e-mail john.berndt@nrc-cnrc.gc.ca.

The inaugural meetings of the China-Canada building code subcommittee began in Beijing in July 2000 and included the participation of NRC's Institute for Research in Construction (IRC) (see *Construction Innovation*, Volume 6 Number 4, Fall 2001). Ongoing strategic direction for Canada's input was provided through a joint government/industry committee chaired by IRC, with representatives from

- CMHC
- NRCan
- Department of Foreign Affairs and International Trade
- Forintek
- Council of Forest Industries
- National Lumber Grades Authority
- Quebec Wood Export Bureau.

Registry of Product Evaluations

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The Registry of Product Evaluations contains all Evaluation Reports and Listings on products evaluated by CCMC (over 600 products). It is indexed to the MasterFormat system used throughout North America. Using the CCMC Registry online, thousands of users can quickly access technical and standards-related data on hundreds of evaluated materials, products and construction systems.

SkyVision software validation process completed

IRC has released the final version of its SkyVision software for predicting skylight performance after extensive validation testing on the beta version released last year. This release is welcome news for skylight designers, skylight manufacturers, building designers, architects and educators, who can use the tool to predict skylight performance for any given day and for various types of skylights.

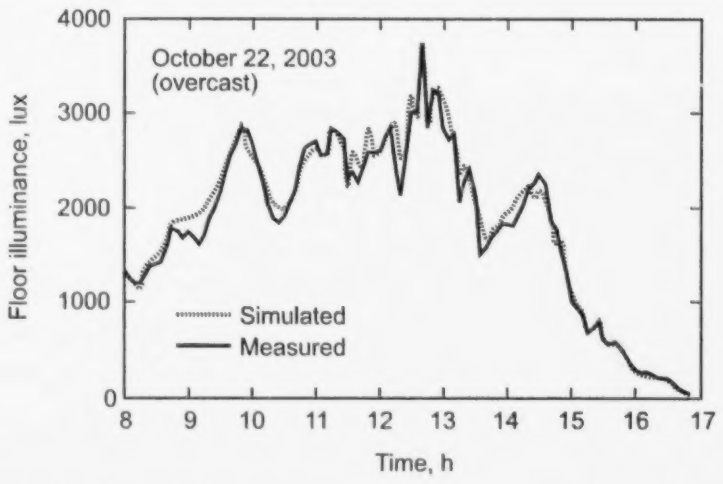
Researchers at IRC conducted testing on seven different skylights. These included two circular dome models, one with clear and one with white acrylic glazing; two rectangular bubble models, one with clear and one with white acrylic glazing; a clear acrylic hexagonal pyramid model; a clear polycarbonate barrel vault model; and a tubular model.

The researchers measured skylight transmittance, skylight indoor illuminance, outdoor global irradiance and illuminance, and outdoor diffuse irradiance and illuminance. Each measurement required a special set-up to accurately characterize the skylight performance.

There were multiple challenges involved in developing the model, including being able to calculate—for any given day—the optical characteristics of the various skylight types, the amount of light transmission through the skylight system into the interior space at a particular angle relative to the sun's altitude, and the overall amount of daylight provided to the interior space.

When the software's predictions for skylight transmittance were compared with the actual measurements, the results were found to be very similar, particularly for the dome, bubble and barrel vault skylights. Prediction of skylight transmittance for the tubular skylight compared slightly less favourably because it was not possible to model its light-enhancing devices with SkyVision. Overall, the software's prediction of the average indoor illuminance (see figure) also compared well with the measurements. A full report on the validation study is available at http://irc.nrc-cnrc.gc.ca/ie/light/skyvision/publications.html.

Specific questions about SkyVision can be directed to Dr. Abdelaziz (Aziz) Laouadi at (613) 990-6868, fax (613) 954-3733, or e-mail aziz.laouadi@nrc-cnrc.gc.ca.



Average floor illuminance from clear barrel vault skylight

SKYVISION

Final SkyVision software is now available

SkyVision is an easy-to-use Windows-based software program developed by researchers in IRC's Indoor Environment Program. It predicts skylight performance for any given day and for various types of skylights, making it easier to select suitable skylights for various conditions, as well as to improve the design of skylights currently being manufactured. The final version of the SkyVision software can be downloaded from http://irc.nrc-cnrc.gc.ca/ie/light/skyvision/download.html.

IRC conducted the SkyVision research with financial contributions from Natural Resources Canada through its CETC Buildings Group and Panel on Energy Research and Development (PERD), and from Public Works and Government Services Canada. In addition, a number of companies donated skylight products for testing, including Artistic Skylight Domes Ltd. in Etobicoke, Ontario; Mac Plastics Ltd. in Edmonton, Alberta; and Energy Harmony in St. Catharines, Ontario.

Building Science Insight
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Building a Better Cubicle
Cost-effective office design

Organized by: Institute for Research in Construction
National Research Council Canada

The single most common workplace in North America is the partitioned open-plan office, or "cubicle." People who work in this type of office spend more waking hours in this environment than in any other, and there is abundant evidence that they do not generally enjoy the experience.

This one-day seminar will address how open-plan offices can be ergonomically designed to improve the workplace environment and occupant satisfaction, with consequent benefits to an organization's bottom line.

The seminar will address several topics:

Organizational Productivity. Defining productivity for "white-collar" work is notoriously difficult. Nevertheless, there is a growing body of evidence to suggest that improved environmental satisfaction is linked to increased job satisfaction and superior organizational productivity. A multi-dimensional model of organizational productivity will be described and evidence regarding the effects of the office environment reviewed.

Workstation Design. The open-plan office should be designed to meet:
1. the needs of the task
2. the need to control information flow
3. the need for individual recognition within the organization.

These needs are better served if employees have input into the design process and the possibility of modifying their environment when necessary.

Acoustics. Most office workers desire speech privacy when at their desk. They do not want to be overheard or to be distracted by conversations elsewhere in the office. The effect of office design parameters, such as cubicle size, partition height, ceiling-tile characteristics and the use of masking noise on speech privacy and occupant satisfaction, will be illustrated.

Ventilation, Indoor Air Quality and Thermal Comfort. A successful ventilation strategy for an office building is founded upon controlling pollutant sources and supplying an adequate level of outdoor air for the number of occupants. In addition, local sources of thermal discomfort and draft should be controlled. Appropriate strategies will be discussed.

Lighting and Daylighting. Research shows that people prefer bright spaces, as long as they are glare- and flicker-free. Satisfaction is also improved with access to daylight. Office design choices can have a substantial effect on the luminous environment. The effect of lighting equipment types, cubicle size, partition height, surface colours and ceiling height will be demonstrated.

Seating, Posture and Office Equipment. A growing number of office workers report musculoskeletal injuries attributed to poor workstation ergonomics. The proper design of seating, work surfaces and computer equipment will be reviewed in the context of the CSA Guideline on Office Ergonomics, and examples of positive ergonomic interventions presented.

Software Tools. IRC has developed two free software tools to aid in the design of open-plan office environments. The first focuses on acoustics and speech intelligibility, and the second examines the office environment more broadly, indicating both physical and occupant-satisfaction effects. The seminar will include tutorials on both software tools, with worked examples.

The one-day seminar will be held in the following locations:

- ***Fredericton, October 13, 2004***
- ***Charlottetown, October 15, 2004***
- ***St. John's, October 18, 2004***
- ***Halifax, October 20, 2004***
- ***Edmonton, November 1, 2004***
- ***Yellowknife, November 3, 2004***
- ***Winnipeg, November 5, 2004***
- ***Toronto, November 8, 2004***
- ***Whitehorse, November 16, 2004***
- ***Vancouver, November 18, 2004***
- ***Vancouver, November 19, 2004***
- ***Calgary, November 22, 2004***
- ***Saskatoon, November 24, 2004***
- ***Toronto, November 26, 2004***
- ***Ottawa, December 2, 2004***
- ***Sainte-Foy (French), January 18, 2005***
- ***Montreal (French), January 20, 2005***

The registration fee for the seminar is $329 plus tax. Go to the Web site (http://irc.nrc-cnrc.gc.ca/bsi/2004) for more details and registration information.

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Revised: June 2004

CI

Collaborating to light offices "right": IRC teams up with Lighting Research Center

A research project to study lighting quality carried out in IRC's Indoor Environment Research Facility in the '90s established that good quality lighting design can improve occupant satisfaction and task performance, and, at the same time, be energy efficient (see *Construction Innovation*, Winter 1998, or visit http://irc.nrc-cnrc.gc.ca/ie/light/lq_project/lqp.html).

Industry welcomed this evidence, but questions remained about whether the effects could be observed in the field. And while market research has found that decision-makers will chose lighting products that improve employee satisfaction, health and productivity, for the most part, they lack specific information about which products or lighting designs to choose.

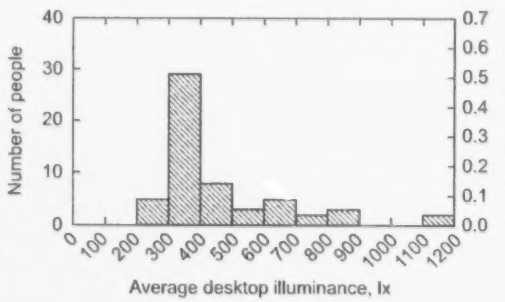
To answer these questions for the industry, IRC recently teamed up with the Lighting Research Center at Rensselaer Polytechnic Institute in a project sponsored by the Light Right Consortium (see sidebar, p. 9). For this investigation, an office in a commercial office building was furnished as a typical open-plan workplace for nine workers, with perimeter windows allowing access to a view, but with only limited daylight penetration. Temporary office workers were hired to work under one of several lighting installations for a full day, completing tasks that involved many different forms of clerical and cognitive office work, and questionnaires concerning satisfaction and mood. Switching and dimming choices were monitored in those designs that offered control of lighting.

The researchers conducted two experiments comparing various types of currently available lighting equipment, making sure to include most types commonly used in North American offices so that the results would provide meaningful guidance to those who make decisions about lighting.

The first experiment compared these scenarios:

- "Base case." This is the most common lighting installation in developer-built buildings (parabolic-louvered luminaires, designed to reduce glare on computer screens).
- "Best practice" system. This is the system that many lighting designers favour (linear direct/indirect luminaires, together with some wall-washing to brighten the walls). There were two variations on this system: one scenario with no individual lighting control, and one featuring individual lighting control using a switchable desk lamp.
- Dimming control. Individual lighting control using one dimmable, suspended direct/indirect luminaire for each cubicle (see photo above).

Is this workplace comfortable? Photo shows field site with individually controlled lighting (dimming control).



Desktop illuminance levels chosen by participants with dimming control (Experiment 1).

The second experiment compared a different "base case" (a regular array of recessed prismatic luminaires) to a modified "best practice" scenario (same as in first experiment, but at a lower light level, and with no desk lamp).

The results of both experiments showed that people who are more satisfied with their lighting rate the space as more attractive, are happier, and are more comfortable and satisfied with their environment and their work. This is the first time that these significant linkages have been demonstrated, providing further justification for choosing lighting designs that increase occupant satisfaction. Although there were few direct effects of lighting design on task performance, the results provide guidance on how to improve satisfaction with office lighting:

- **Add an indirect lighting contribution.** Although current lighting practice

Continued on page 9

New international project to study whole-building heat, air and moisture flows

In many ways, buildings take on a life of their own. They age and they breathe as their heating, ventilation and air conditioning (HVAC) systems take in and release air. But this airflow can distribute air pressure differences within the building that can cause changes in the heat and moisture response of the building envelope. These changes, in turn, affect energy consumption and the envelope's durability. They can also affect indoor relative humidity, which can cause thermal and respiratory discomfort.

To gain some insight into what is happening in the building as a whole, the International Energy Agency (IEA) is launching a major international, four-year project to study the heat, air and moisture flows in buildings. They are particularly interested in how these flows affect the indoor environment, the durability of the building envelope, and energy consumption. The IEA is an autonomous agency linked with the Organisation for Economic Co-operation and Development (OECD).

Researchers from 19 countries, including Canada, were involved in developing the project's focus. They will undertake a detailed exploration of the complex physics involved in whole-building heat, air and moisture response. This exploration will use a broad range of techniques, including basic research, new and existing models, examination of building materials, mock-up testing and field-testing. In addition, they intend to analyze the effects of the whole-building heat, air and moisture response on comfort, building envelope durability and energy consumption.

IRC has volunteered to lead one of the sub-tasks of the international project. This will involve developing international consensus on how to measure both indoor and outdoor climatic parameters in order to be able to carry out hygrothermal analyses of buildings. Other Canadian participants include Concordia University, which will conduct full-scale experiments on building envelope components, and the University of Saskatchewan, which will provide information on the effects of different ventilation strategies on indoor climatic conditions in buildings and benchmarking data for other Annex participants.

In its lead role for the IEA study, IRC is seeking participation from other government departments and the building industry. The long-term performance of a number of building products depends on the ability of whole-building designs to handle variations in indoor and outdoor humidity. Manufacturers of these products may be particularly interested in participating because this would give them early access to information from the study, as well as insight into national and international perspectives and experience on this issue.

If you are interested in learning more about this project or participating in it, please contact Dr. Kumar Kumaran at (613) 993-9611, fax (613) 998-6802, or e-mail kumar.kumaran@nrc-cnrc.gc.ca.

Users think CTUs are useful and relevant

A recent survey indicates that construction practitioners hold IRC's *Construction Technology Updates* (CTUs) in high regard.

IRC sent a one-page survey form to 500 subscribers. Almost 100 people returned the form, an excellent response rate of 20%.

The form contained four statements on which respondents were asked to state their opinions (agree or disagree). Here are those statements and the results.

1. CTUs impart new knowledge in construction science and technology.
   56 people strongly agreed and 42 agreed.
2. The information contained in CTUs is not available in other publications.
   16 users strongly agreed, 67 agreed and 12 disagreed.
3. The information in CTUs is relevant to my work.
   41 users strongly agreed, 56 agreed and 1 disagreed.
4. The technical level of the information is appropriate for me.
   37 strongly agreed, 57 agreed and 5 disagreed.

Thirty-six respondents provided brief comments, which were overwhelmingly positive. Some users expressed a desire for more technical content. Others suggested a need for more detail to solve problems; one suggestion was to give links to reports on the IRC Web site for more detailed information. We will do our best to act on users' suggestions.

IRC wishes to thank those who took the time to respond. We appreciate your input.

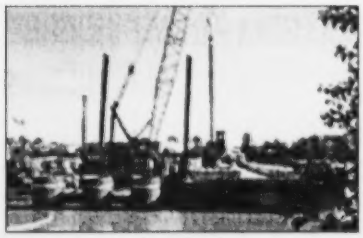
You can give us your comments by accessing the CTU Web page at: **http://irc.nrc-cnrc.gc.ca/catalogue/ctu.html** and clicking on the box entitled: **Tell us what you think of the Updates.**

Fraser River Pile & Dredge Ltd. wins Excellence in Innovation Award

At its 86th Annual Conference in March, the Canadian Construction Association (CCA) presented its awards to honour the outstanding contribution of individuals, companies and organizations within the Canadian construction industry. CCA's Excellence in Innovation Award, sponsored by the Institute for Research in Construction, was presented to Fraser River Pile & Dredge Ltd. of New Westminster, BC for its innovative caisson dredging technique.

This technique, developed for a remediation project on the Fraser River, involves driving in and draining cylindrical caissons before removing contaminated sediments, which minimizes the impact on the surrounding ecosystem. There are two main benefits of the procedure: 1) it allows for a better separation of different types of sediment, thereby significantly reducing the costs of additional remediation prior to disposal, and 2) it eliminates the possibility of water contamination and the need to treat this water because the caisson is first drained of surface water.

Due to the strict water-quality requirements for work in the Fraser River, and the high costs associated with the disposal of water with contaminated sediments, the caisson dredging technique scored high marks. The technique not only provides important environmental benefits, productivity improvements and significant cost savings when compared to traditional methods, but also high levels of predictability and sustainability.



Innovative caisson dredging technique by Fraser River Pile and Dredge Ltd. wins CCA Excellence in Innovation Award.

An honourable mention was also given by the jury committee to PCL Construction Management Inc. of Regina, Saskatchewan, for their Innovative Cantilever Bridge Deck Formwork system.

The development and promotion of innovative ideas within the construction sector is one of IRC's top priorities. The Institute is therefore very pleased to support this major national construction award. Congratulations, Fraser River Pile and Dredge Ltd!

Collaborating to light offices "right": IRC teams up with Lighting Research Center

Continued from page 6

is acceptable, showing high levels of comfort for both "base case" lighting designs (approximately 70% of the participants rated these as comfortable), the direct/indirect installations were rated as comfortable by approximately 80% of the participants.

- **Provide lighting control for occupants.** Approximately 90% of the participants rated individual dimming control as comfortable. When they had control, most people used it once, near the start of the day, to choose a preferred condition, which varied widely from one person to another (see figure, p. 7). People with dimming control showed more sustained motivation over the workday and improved performance on a measure of attention. Participants who experienced both the "base case" and "dimming control" conditions reported higher ratings of lighting quality, overall environmental satisfaction, and rates of productivity (self-rated) in the "dimming control" condition.

For more information, please contact Dr. Jennifer Veitch at (613) 993-9671, fax (613) 954-3733, e-mail jennifer.veitch@nrc-cnrc.gc.ca, or visit http://irc.nrc-cnrc.gc.ca/fulltext/b3214.1/ for the full report.

Light Right Consortium

IRC together with the Lighting Research Center won a competitive bid for this research, which was funded by the Light Right Consortium. Light Right brings together interested parties and researchers to work toward a common goal: to use research as a basis for a market transition to ergonomic lighting. This type of lighting is designed and installed in a way that takes into consideration both the physical and psychological needs of people in buildings—it is of high quality, energy efficient and economical.

The Light Right Consortium project is managed by Pacific Northwest National Laboratory, operated by Battelle Memorial Institute for the U.S. Department of Energy. Members for Phase 2 of the project were: Alliance to Save Energy, Illuminating Engineering Society of North America, International Association of Lighting Designers, International Facility Management Association, Johnson Controls, National Electrical Manufacturers Association, New York State Energy Research and Development Authority, Steelcase, U.S. Department of Energy, U.S. Environmental Protection Agency.

For more information about the Light Right Consortium visit http://www.lightright.org.

Risk of corrosion in concrete structures reinforced with stainless steel and carbon steel investigated

Corrosion of the steel reinforcement used in the construction of concrete structures, such as highway bridges and parking garages, can lead to major problems in terms of reduced safety and serviceability of these structures, and increased rehabilitation costs. To help address this problem, researchers in IRC's Urban Infrastructure Program established a consortium research project to investigate the effectiveness of combining carbon steel and stainless steel to extend the service life of concrete structures.

Conventional carbon steel reinforcement used in concrete structures is susceptible to corrosion, particularly in areas exposed to de-icing salts. Stainless steel, on the other hand, has superior corrosion resistance but has had limited application in this type of structure due mainly to its higher initial cost.

While the cost of stainless steel can be five to eight times that of carbon steel, it can last three or four times longer. This suggests that combining stainless steel and carbon steel in concrete structures—using the stainless steel only in areas with a high risk of corrosion and the carbon steel in the low-risk areas—could be a viable option for reducing construction and rehabilitation costs, and extending service life. It could also eliminate the need for other preventative strategies, such as rebar coatings and corrosion inhibitors.

Galvanic corrosion occurs when two different metals—with different electrical potentials—come in contact in corrosive environments (solutions or atmospheres), causing an electric current to flow between them.

However, concern about the high initial cost of stainless steel is not the only issue preventing widespread use of this material. There is also concern about the risk of galvanic corrosion between two different metals, which has prevented the coupling of these reinforcing materials from being used in the field. Engineers responsible for the design, construction and rehabilitation of concrete structures are reluctant to partially replace carbon steel with stainless steel because they believe this may increase the risk of corrosion through the introduction of a different metal.

To find out whether the rate of galvanic corrosion really does increase when stainless steel and carbon steel are coupled, and to what extent, the IRC research team conducted various experiments to investigate what happens when these materials are combined in:

1) a saturated calcium hydroxide solution, simulating the inherent properties of concrete, plus sodium chloride (de-icing salts);
2) concrete specimens with different concentrations of sodium chloride, simulating a concrete structure in the field.

The results showed that the coupling of stainless steel and carbon steel in concrete structures does not increase the risk of corrosion. In fact, the rate of galvanic corrosion in the stainless steel/carbon steel combination was less than in the corroded carbon steel/un-corroded carbon steel combination.

Based on the results of this investigation, the researchers concluded that the judicious use of stainless steel with carbon steel in areas with a high risk of corrosion can be a cost-effective option for preventing corrosion and improving the durability of concrete structures. There is, however, one proviso: the stainless steel needs to be protected from contamination by rust from carbon steel because a significant amount of rust on the stainless steel can lead to increased galvanic action between the two metals and hence to further corrosion in the corroded carbon steel.

Situations that might warrant using stainless steel include those areas that are directly exposed to de-icing salts, and therefore vulnerable to corrosion, such as:

- the top layer of reinforcing steel in bridge decks
- the lower portion of columns (exposed to de-icing salt spray)
- the splash zone or edge beam of highway bridges.

The study demonstrated that the two different types of reinforcement can be used in both new construction and repair applications.

Specific questions on this project and its findings can be directed to Dr. Shiyuan Qian at (613) 993-3814, fax (613) 952-8102, or e-mail shiyuan.qian@nrc-cnrc.gc.ca.

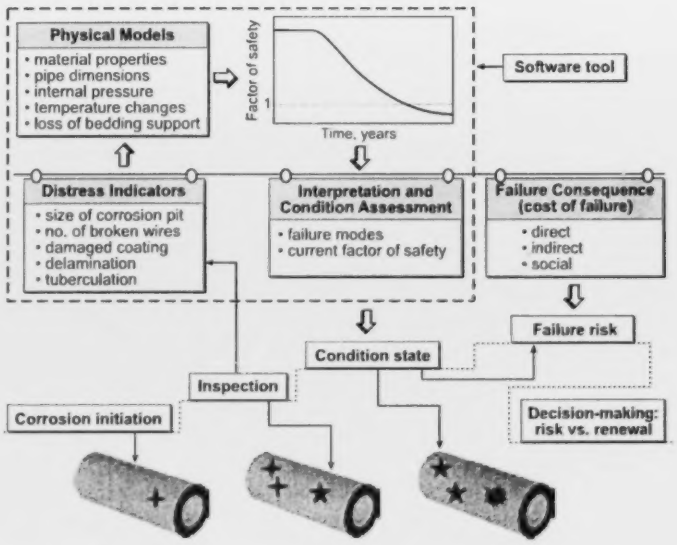
The partners in the project include the Nickel Development Institute, Alberta Transportation, City of Ottawa, Ministère des Transports du Québec and Valbruna Canada Ltd.

Innovative tool to model remaining service life of water pipes developed at IRC

Pipeline replacement and repair is big business. Municipalities in North America spend, by some accounts, over $1 billion annually on breakage repair alone, and these costs are increasing as more and more networks deteriorate each year. To assist municipalities in targeting their rehabilitation resources wisely, researchers in IRC's Urban Infrastructure Rehabilitation program have developed an innovative decision-support software tool to help assess pipeline conditions, determine the remaining service life of pipes, and conduct forensic analysis of pipe failures.

Used throughout a water distribution network, this software will be able to provide municipalities with information that allows them to develop a proactive pipeline repair and maintenance strategy, which could, in turn, lower costs and reduce service disruptions.

The software takes the results of non-destructive tests (NDT) from pipe inspections (distress indicators) and combines them with knowledge of the pipe characteristics, material properties and construction details. It also factors in stresses that may have been placed on the pipe, including frost loading, temperature variations, loss of bedding support, and reductions in structural resistance and tensile strength. The uncertainties associated with all these factors are taken into consideration as well.



This figure illustrates the steps involved in determining the factor of safety and the service life for a pipe using the IRC decision-support tool.

Once the information is in place, the software uses several different models that assess the condition of the pipe at different stages in its lifecycle, to evaluate the remaining factor of safety as well as estimate a time range for the pipe service life. If a pipe has already failed, the software can help determine the cause of failure.

Used throughout a water distribution network, this software will be able to provide municipalities with information that allows them to develop a proactive pipeline repair and maintenance strategy, which could, in turn, lower costs and reduce service disruptions.

The software continues to be refined and validated as more data become available. Those interested in learning more about this project or in contributing data from non-destructive pipe inspections—for example, data on wall thickness loss, existing soil conditions and pipe characteristics—can contact Solomon Tesfamariam at (613) 993-2448, fax (613) 954-5984, or e-mail solomon.tesfamariam@nrc-cnrc.gc.ca.

Upcoming events

JULY

4-7

13th International Brick/Block Masonry Conference. Amsterdam. http://www.13-IBMaC.bwk.tue.nl

AUGUST

1-4

ASCE International Conference 2004. Pipeline Engineering & Construction. San Diego. http://www.asce.org/conferences/pipelines2004/

16-19

Third Civil Engineering Conference in the Asian Region (3rd CECAR). Seoul, Korea. http://www.3rdcecar.com/

23-29

Orthotropic Bridge Conference. Sacramento, CA. http://www.orthotropic-bridge.org/

SEPTEMBER

26-29

18th National Conference and Trenchless Symposium: Advances in Tunnelling & Trenchless Techniques. Edmonton. Contact: Albert Kwan at (780) 496-6852; http://www.apegga.org/events/calendar_dates_sept.html

29-1st Oct

29th Annual Conference on Deep Foundations. Vancouver. http://www.dfi.org/conferencedetail.asp?id=36

29

Nanotechnology for Construction Materials Workshop. Precedes RILEM TC 197-NCM Committee Meeting (Committee on Nanotechnology) on Sept. 30. Workshop and Meeting hosted by NRC-IRC. Contact: Laila Raki at (613) 991-2612; e-mail: laila.raki@nrc-cnrc.gc.ca

OCTOBER

Building Science Insight
Seminar Series – 2004

For seminar dates and locations go to advertisement in centre of this issue.

17-19

57th Annual Conference of the Atlantic Canada Water Works Association. Charlottetown. http://www.acwwa.ns.ca/awwa/index.html

20-23

Baltimore 2004. ASCE Civil Engineering Conference & Exposition. Baltimore, MD. http://www.asce.org/conferences/annual04/

28-30

4th International Conference on Decision-making in Urban & Civil Engineering. Porto, Portugal. http://www.dec.uc.pt/dmuce4

NOVEMBER

2-6

World Engineers' Convention 2004. Shanghai, China. http://www.wec2004.org/

4-7

APTI Conference 2004. Annual Conference of the Association for Preservation Technology. Galveston, TX. www.apti.org

2005 APRIL

17-20

10th International Conference on DBMC (Durability of Building Materials and Components). Lyon, France. http://www.10dbmc.cstb.fr

This calendar does not include all events scheduled to take place during this time frame. For a more complete listing, see the Web version of "Upcoming events" at http://irc.nrc-cnrc.gc.ca/events.html

construction *innovation*

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